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DERWENT-ACC-NO: 1994-245893
DERWENT-WEEK: 199430

TITLE: Chromium@-molybdenum@ system electric welded steel pipe for reinforcing motor car doors - contains carbon, silicon@, manganese@, phosphorus, sulphur, aluminium@, boron, nitrogen, titanium@, niobium and iron@

PRIORITY-DATA: 1992JP-0334671 (December 15, 1992)

PATENT-FAMILY:

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INT-CL (IPC): C22C 38/38

ABSTRACTED-PUB-NO: JP 06179945A
BASIC-ABSTRACT:

Pipe comprises (by wt.%) 0.15-0.30 C, 0.05-0.50 Si, 2.0-3.0 Mn, 0.005-0.020 P, 0.0005-0.0060 S, 0.01-0.08 Al, 0.001-0.003 B, 0.002-0.0050 N, 0.1-0.7 Cr, 0.1-1.5 Mo, at least 1 of 0.01-0.20 Ti, and 0.01-0.20 Nb, and balance Fe and impurities, comprising a structure of martensite, and bainite obtd. by normalising. The pipe has a tensile strength of 150-180 kgf/mm2, elongation of at least 10%, and yield ratio of 0.70-0.85. 1471 - 1765.26 MPA

USE/ADVANTAGE - Used for door reinforcement of cars. The pipe has good superhigh tensile strength and toughness.

ABSTRACTED-PUB-NO: JP 06179945A
EQUIVALENT-ABSTRACTS:

CHOSEN-DRAWING: Dwg.0/0

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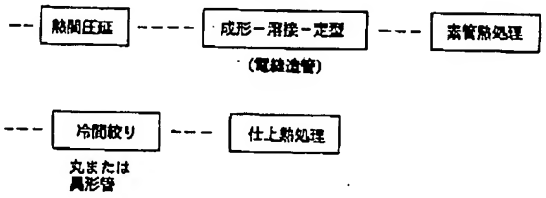
(54)【発明の名称】　延性の優れたＣｒ－Ｍｏ系超高張力電縫鋼管

(57)【要約】　（修正有）

【目的】　自動車等の構造部材に使用される引張り強度１５０ｋｇｆ／ｍｍ² 以上、伸び１０％以上の延性の優れたＣｒ－Ｍｏ系超高張力電縫鋼管を提供する。

【構成】　成分組成が重量でＣ：０．１５～０．３０％、Ｓｉ：０．０５～０．５０％、Ｍｎ：２．０～３．０％、Ｐ：０．００５～０．０２０％、Ｓ：０．０００５～０．００６０％、Ａｌ：０．０１～０．０８％、Ｂ：０．００１～０．００３％、Ｎ：０．００２～０．００５０％、Ｃｒ：０．１～０．７％、Ｍｏ：０．１～１．５％に、Ｔｉ：０．０１～０．２０％、Ｎｂ：０．０１～０．２０％の１種以上を含有させる残部Ｆｅ及び不可避的元素よりなる電縫鋼管で、熱処理として焼準を行ない、引張強度が１５０～１８０ｋｇｆ／ｍｍ² で伸びが１０％以上、降伏比が０．７０～０．８５とした。

図２



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【特許請求の範囲】
【請求項1】　成分組成が重量で
C：0．15～0．40%、
Si：0．05～0．50%、
Mn：2．0～3．0%、
P：0．005～0．020%、
S：0．0005～0．006%、
Al：0．01～0．08%、
B：0．0010～0．0030%、
N：0．002～0．005%、
Cr：0．1～0．7%、
Mo：0．1～1．5%
を含有し残部Fe及び不可避的元素よりなる電縫鋼管で、焼準によるマルテンサイトとベイナイト主体の組織からなり、引張強度が150～180kgf／mm²で伸びが10%以上、降伏比が0．70～0．85であることを特徴とする延性の優れたCr－Mo系超高張力電縫鋼管。
【請求項2】　成分組成が重量で
C：0．15～0．40%、
Si：0．05～0．50%、
Mn：2．0～3．0%、
P：0．005～0．020%、
S：0．0005～0．006%、
Al：0．01～0．08%、
B：0．0010～0．0030%、
N：0．002～0．005%、
Cr：0．1～0．7%、
Mo：0．1～1．5%に、
Ti：0．01～0．20%、Nb：0．01～0．20%以下を1種または2種を含有し残部Fe及び不可避的元素よりなる電縫鋼管で、焼準によるマルテンサイトとベイナイト主体の組織からなり、引張強度が150～180kgf／mm² で伸びが10%以上、降伏比が0．70～0．85であることを特徴とする延性の優れたCr－Mo系超高張力電縫鋼管。
【請求項3】　電縫鋼管が角形または異形鋼管であることを特徴とする請求項1または2記載の延性の優れたCr－Mo系超高張力電縫鋼管。
【発明の詳細な説明】
【0001】
【産業上の利用分野】本発明は自動車等の構造部材に使用される超高張力電縫鋼管、特にドア補強用の引張り強度が150kgf／mm² 以上、伸びが10%以上である経済的で延性の優れたCr－Mo系超高張力電縫鋼管に関する。
【0002】
【従来の技術】自動車等の構造部材については、燃費向上・環境対策のために徹底した軽量化が検討されており、安全性との両立を図る方策の一つとして一部部材で

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は150kgf／mm² を超える超高張力鋼管が採用されつつある。
【0003】自動車ドア補強用の鋼管材料としては、特開平3－122219号公報等に記載されているように電縫造管後調質即ち焼入または焼入焼戻をする方法、および特開平3－140441のような所定の低合金鋼を焼準する方法が一般的である。
【0004】
【発明が解決しようとする課題】従来の技術としては、従来の技術の項に記載したように2つのタイプがある。まず、特開平3－122219号公報等に記載されているような方法では、ピース毎に処理する特殊な熱処理設備を必要とし、寸法形状、材質の確保に特別の注意が必要であり、生産性が低く、設備投資・生産性の点で著しくコストの高いものとなっている。更により剛性の高い構造部材として注目されている角型鋼管、異形鋼管の製造法としては寸法精度の確保上、不適当である。
【0005】次に、特開平3－140441のような所定の低合金鋼の焼準する方法は、上記の焼き入れタイプの問題点を解消できるが成分によっては材料費が高くなり、延性が悪化する場合がある。特開平3－140441の場合はMnが3%を越えており転炉での製造が事実上不可能であり、また、Ni等の高価な成分が含まれている。また、鋼管の製造方法および伸びについては明かにされていない。本発明は焼準タイプで従来法よりも経済的で、製造も容易であり、引張り強度が150kgf／mm² 以上、かつ延性が10%以上の優れたCr－Mo系超高張力電縫鋼管を提供することを目的にするものである。
【0006】
【課題を解決するための手段】本発明の要旨とするところは下記のとおりである。
【0007】（1）成分組成が重量でC：0．15～0．40%、Si：0．05～0．50%、Mn：2．0～3．0%、P：0．005～0．020%、S：0．0005～0．006%、Al：0．01～0．08%、B：0．0010～0．0030%、N：0．002～0．005%、Cr：0．1～0．7%、Mo：0．1～1．5%を含有し残部Fe及び不可避的元素よりなる電縫鋼管で、焼準によるマルテンサイトとベイナイト主体の組織からなり、引張強度が150～180kgf／mm² で伸びが10%以上、降伏比が0．70～0．85であることを特徴とする延性の優れたCr－Mo系超高張力電縫鋼管。
【0008】（2）成分組成が重量でC：0．15～0．40%、Si：0．05～0．50%、Mn：2．0～3．0%、P：0．005～0．020%、S：0．0005～0．006%、Al：0．01～0．08%、B：0．0010～0．0030%、N：0．002～0．005%、Cr：0．1～0．7%、Mo：

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0．1～1．5%に、Ti：0．01～0．20%、Nb：0．01～0．20%以下を1種または2種を含有し残部Fe及び不可避的元素よりなる電縫鋼管で、焼準によるマルテンサイトとベイナイト主体の組織からなり、引張強度が150～180kgf／mm² で伸びが10%以上、降伏比が0．70～0．85であることを特徴とする延性の優れたCr－Mo系超高張力電縫鋼管。

【0009】（3）電縫鋼管が角形または異形鋼管である前記（1）項または（2）項記載の延性の優れたCr－Mo系超高張力電縫鋼管。

【0010】以下に本発明を詳細に説明する。最初に本発明に使用する鋼板の成分のうち請求項1～3に共通の成分について限定理由を説明する。

【0011】C量は少なければ延性が良好であり、加工性に優れているが、所要の強度が得られないことから下限を0．15%とした。又、0．40%を超えると造管時の成形性等の冷間加工性及び靭性が低下する傾向にあり、又、電縫鋼管の造管溶接時に熱影響部が硬化し、切断等で支障を来すことから、上限を0．40%とした。

【0012】Siはキルド鋼の場合、0．05%未満におさえることは製鋼技術上難しく、又、0．5%を超えると電縫溶接性および靭性が悪化するため、0．5%を上限とした。

【0013】Mnは、強度と延性のバランスが良く、強度を上げ、伸びを確保するためには最低2．0%以上必要である。又3．0%を超えると転炉での溶製が極めて困難になることから、下限を2．0%、上限を3．0%とした。

【0014】Pは製鋼時不可避的に混入する元素であるが、0．005%未満にすることは製鋼技術上難しく、0．020%を超えると特に超高張力鋼管の電縫溶接時に溶接部割を発生しやすいため、下限を0．005%、上限を0．020%とした。

【0015】SもP同様製鋼時不可避的に混入する元素であり、0．0005%未満にすることは製鋼技術上難しく、0．0060%を超えると電縫溶接時に溶接部割を発生しやすいため、下限を0．0005%、上限を0．0060%とした。Sによる電縫溶接時の割を更に抑制するには、MnSを形態制御する元素であるCaを添加してもよい。

【0016】Alはキルド鋼の場合、0．01%未満におさえることは製鋼技術上難しく、又、0．08%を超えると鋳片の割れ、酸化物系巨大介在物形成による内質欠陥等をひきおこしやすいため、下限を0．01%、上限を0．08%とした。

【0017】Bは冷却過程においてフェライト変態を遅らせて高強度変態組織を得るために必須の元素であるが、本発明鋼の成分組成においても0．001%未満では強度不足となり、0．003%を超えるとBoron

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Constituentが生成して延靭性が著しく低下するため、下限を0．001%、上限を0．003%とした。

【0018】Nは製鋼時不可避的に混入する元素であるが、0．002%未満におさえることは製鋼技術上難しく、0．005%を超えるとTi、Bの強度上昇効果を阻害して強度不足をひきおこすため、下限を0．002%、上限を0．005%とした。

【0019】Moはフェライト変態を抑制し、細粒化に効果があり、析出強化する特徴を有し、造管後の熱処理によりマルテンサイトとベイナイト主体の組織を得て、強度を上げるのに有効であるため、0．1%以上を含有させる。しかし、1．5%を超えて添加しても効果の向上が少なく、延性の劣化を招くことから、下限を0．1%、上限を1．5%とした。

【0020】Crは比較的経済的な成分であり、フェライト変態を抑制し、造管後の熱処理によりマルテンサイトを含むベイナイト組織を得て、強度を上げるのに有効であるため、0．1%以上を含有させる。この場合、0．7%を超えて添加するとERW造管でCrの酸化物による溶接欠陥が発生し易くなり、面倒な不活性ガスシール溶接が必要である。したがって、上限を0．7%とした。

【0021】Ti、Nbについては、Moと同様に熱間圧延での未再結晶γ域を広げるために細粒化に効果があり、析出強化し、いずれも鋼材の強度を上昇させる元素であり、超高張力電縫鋼管の製造に有効であるため、0．01%以上を含有させてもよい。しかし、0．20%を越えると延靭性を害するのでTi、Nbの下限は0．01%、上限をそれぞれ、0．20%とした。

【0022】次に製造工程について説明する。本発明による電縫鋼管の製造工程の一例を図1に示す。本発明に従い、上記成分の鋼を熱間板厚圧延時に950℃以下Ar_3変態点以上で仕上圧延を終了することが望ましい。これは、特に靭性の改善が望まれる場合、および低強度の鋼板を得て造管を容易にする場合に必要である。950℃超では未再結晶域での圧延が存在しないため強度・延靭性が劣化し、Ar_3 変態点未満では2相域圧延によって強度は上昇するが延靭性が著しく低下する。よって上記成分の鋼を熱間板厚圧延時に950℃以下Ar_3 変態点以上で仕上圧延を終了し引続き本発明の条件で巻取ることによって、後工程での製造が容易な低強度で延性の優れた材質とすることができる。

【0023】巻取温度は600℃以上で巻取れば、コイル内の冷却速度は炉冷に近いため、Mo等の析出は過時効し、フェライトが析出して比較的に低強度で延性のある鋼板を製造できる。このように製造された鋼板は電縫管に造管するに十分な延性を有する。

【0024】造管後に熱処理として焼準を行なう。これはAc_3 点以上に加熱してオーステナイト化した後に空

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冷並の冷却で、フェライトの生成を抑制し、マルテンサイトとベイナイト主体の組織とし、強度上昇をはかる。焼準温度は温度のばらつきを考慮してAc_3＋20℃以上とし、上限は細粒を保ち強度延性のバランスを確保するため、Ac_3＋70℃以下が望ましい。また、ここでの空冷は300℃までの冷却速度が10～150℃／分の範囲である。Ac_3点未満の熱処理では上記の効果が得られず所定の強度が得られない。

【0025】以上本発明の請求項1および請求項2に記載の電縫鋼管について説明したが、請求項3記載の電縫鋼管でもよい。図2は請求項3記載の方法に従った工程を示す。このように冷間絞り加工を付加することにより、曲げ強度の優れた角型鋼管、異形鋼管の製造が可能である。角型および異形鋼管の形状例を図3に示す。冷間絞り加工は、ダイス引き抜きによる方法とロールフォーミングによる方法がある。素管熱処理は造管時の冷間加工による加工歪を除去し、電縫溶接部の焼き入れ硬化部を軟化し、冷間絞り加工性を改善するためであり、600℃以上の軟化焼鈍または焼準を行なう。冷間絞り後は、冷間加工歪を除去し、強度延性のバランスを改善するために焼準を行なう。ただし、素管熱処理として焼準を行なった場合は既に強度は十分に上昇しているため、冷間絞り後の仕上げ熱処理は焼鈍でもよい。このようにすれば冷間加工による加工硬化量と焼鈍温度の組合せで適当な強度－延性バランスが得られる。焼鈍温度は冷間加工率によるが450℃以上から効果がある。

【0026】

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【実施例】表1に、サイズφ34．1×t2．0mmの電縫鋼管を従来法および本発明法により製造した条件および結果を示す。ここでの冷間伸管はダイスを用いて角形状に空引きを行なった。従来法では150kgf／mm² 以上の引張強度を達成しても伸びは10%を達成できないが、本発明法では達成できる。また、本発明によれば、降伏比（＝降伏強度／引張強度）が0．70～0．85と低くできる。曲げ時の座屈は降伏比が低いほど発生しにくいため、曲げ吸収エネルギーが大きくなり本発明は有利である。また、本発明は造管後に焼準の熱処理を加えることによって母材部・溶接部が均一で強度・延靭性バランスの優れた超高張力電縫鋼管を得ることができる。熱処理後に更に冷間伸管加工を付加することにより、各種寸法を容易に製造できるため、小ロット対応が可能であり、経済的である。また、任意の断面に加工できるので曲げ加工性の優れた角管等が製造可能である。更に冷間伸管後に焼準を行うことにより延性を増し、強度－延性バランスを改善する。また、必要に応じて、熱間板厚圧延における仕上圧延温度および巻取温度を適正に制御することにより、低強度で延性の優れた素材鋼板を製造して造管を容易にすることができる。なお、本実施例は冷間伸管を行ったが、要は冷間で絞り加工を行えば加工硬化により強度の上昇が得られるため、ロールフォーミングによる絞り加工でも同様な効果が得られる。

【0027】

【表1】

表 1

No.	区分	化学成分（重量%）											
		C	Si	Mn	P	S	Al	Nb	Mo	Cr	Ti	B	N
1	従来法	0.30	0.25	1.30	0.007	0.0015	0.016	0.021	2.0	0.5	0.019	0.0014	0.004
2	従来法	0.30	0.25	1.60	0.007	0.0015	0.016	0.021	0.5	2	0.019	0.0014	0.004
3	従来法	0.14	0.25	1.60	0.007	0.0015	0.016	0.030	1.5	0.0	0.019	0.0014	0.004
4	本発明2	0.15	0.25	3.00	0.007	0.0015	0.016	0.021	1.5	0.5	0.019	0.0014	0.004
5	本発明2	0.20	0.25	3.00	0.007	0.0015	0.016	0.021	1.0	0.5	0.019	0.0014	0.004
6	本発明2	0.25	0.25	2.50	0.007	0.0015	0.016	0.021	0.7	0.5	0.019	0.0014	0.004
7	本発明2	0.30	0.15	2.50	0.007	0.0015	0.016	0.021	0.5	0.5	0.019	0.0014	0.004
8	本発明2	0.35	0.15	2.00	0.007	0.0015	0.016	0.021	0.5	0.5	0.019	0.0014	0.004
9	本発明2	0.40	0.10	2.00	0.007	0.0015	0.016	0.021	0.3	0.5	0.019	0.0014	0.004
10	本発明2	0.25	0.50	2.50	0.007	0.0015	0.016	0.021	0.7	0.5	0.019	0.0014	0.004
11	本発明2	0.25	0.25	2.50	0.007	0.0015	0.016	0.195	1.0	0.5	0.019	0.0014	0.004
12	本発明2	0.25	0.25	2.50	0.007	0.0015	0.016	0.021	0.7	0.5	0.019	0.0014	0.004
13	本発明2	0.25	0.25	2.50	0.007	0.0015	0.016	0	0.5	0.5	0.197	0.0014	0.004
14	本発明2	0.30	0.25	2.50	0.007	0.0015	0.016	0.105	0.5	0.7	0	0.0014	0.004
15	本発明1	0.30	0.25	2.50	0.007	0.0015	0.016	0	0.5	0.6	0	0.0014	0.004
16	本発明3	0.25	0.25	2.50	0.007	0.0015	0.016	0.021	0.5	0.5	0.019	0.0014	0.004
17	本発明3	0.25	0.25	2.50	0.007	0.0015	0.016	0.021	0.5	0.5	0.019	0.0014	0.004
18	本発明3	0.25	0.25	2.50	0.007	0.0015	0.016	0.021	0.5	0.5	0.019	0.0014	0.004

【0028】

【表2】

表1（続き）

No.	熱間圧延 仕上げ温度(℃)	熱間圧延 巻取り温度(℃)	素管熱処理(℃)	冷間伸管率(%)	仕上げ熱処理(℃)	造管前強度(Kgf/mm²)	最終管品質 強度(Kgf/mm²)	最終管品質 伸び(%)	最終管品質 降伏比
1	890	600	無し	0	850	125	152	8.2	0.80
(2)	890	600	無し	0	850	(171)	155	9.1	0.82
3	890	450	600	20	無し	137	155	4.0	0.95
4	890	600	無し	0	850	140	158	13.2	0.72
5	890	600	無し	0	850	110	162	12.9	0.75
6	860	700	無し	0	850	102	153	12.5	0.81
7	860	700	無し	0	850	89	160	12.3	0.75
8	860	700	無し	0	850	89	155	11.4	0.80
9	890	700	無し	0	850	87	164	10.8	0.79
10	890	700	無し	0	850	102	160	12.1	0.73
11	890	700	無し	0	850	105	180	10.5	0.75
12	890	700	無し	0	850	102	153	12.5	0.78
13	890	700	無し	0	850	89	157	12.3	0.73
14	890	700	無し	0	850	89	161	12.1	0.76
15	890	700	無し	0	850	89	161	12.1	0.80
16	890	700	700	10	850	88	157	12.0	0.81
17	890	700	700	20	850	90	156	12.1	0.80
18	890	700	850	20	600	90	158	11.5	0.85

【0029】

【発明の効果】本発明によれば、電縫造管後に焼入れまたは焼入れ、焼戻しをする必要が無く、ピース毎に処理する特殊な熱処理設備を必要としないため、経済的である。さらに、より剛性の高い構造部材として注目されている角型鋼管、異形鋼管が容易に製造できる。また、従来の焼準タイプに比較すると転炉で製造が可能であり、Ｎｉ等の高価な合金が含まれていないので経済的である。さらに、特性においても引張り強度１５０ｋｇｆ／ｍｍ² 以上、伸び１０％以上の優れた強度－伸びバランスを有し、降伏比が０．７０～０．８５と低くできる超高張力電縫鋼管を製造することが可能になるので、産業上貢献するところが極めて大である。

【図面の簡単な説明】

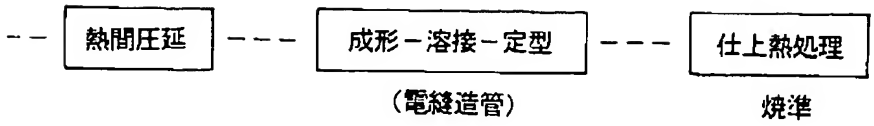
【図１】本発明の請求項１および請求項２に記載の電縫鋼管の製造工程の一例を示す図。

【図２】請求項３に記載の電縫鋼管の製造工程の一例を示す図。

【図３】本発明の角型および異形鋼管の形状例を示す図。

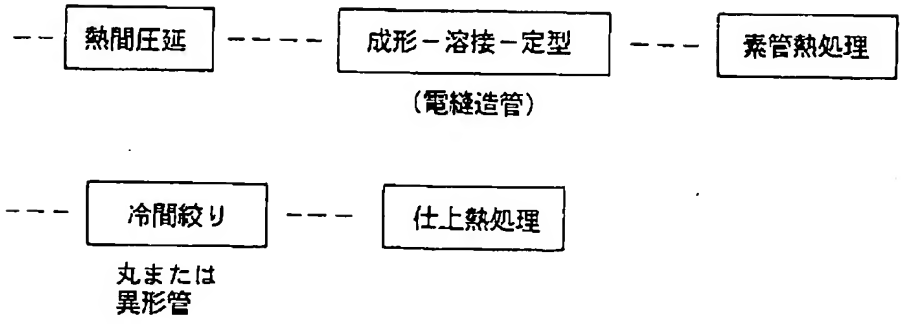
【図1】

図1



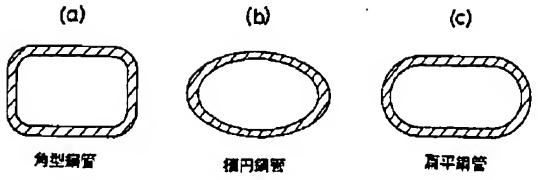
【図2】

図2



【図3】

図3



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CLAIMS

[Claim(s)]
[Claim 1] A component presentation by weight C:0.15 - 0.40%, Si:0.05-0.50%, Mn: 2.0-3.0%, P:0.005 - 0.020%, S:0.0005 - 0.006%, With the electroseamed steel pipe which contains aluminum:0.01-0.08%, B:0.0010 - 0.0030%, N:0.002 - 0.005%, Cr:0.1-0.7%, and Mo:0.1-1.5%, and consists of the remainder Fe and an unescapable element The Cr-Mo system super-high tension electroseamed steel pipe with which it consisted of an organization of the martensite by normalizing, and a bainite subject and with which tensile strength was excellent in the ductility characterized by elongation being [10% or more and a yield ratio] 0.70-0.85 by 2 150 to 180 kgf/mm.
[Claim 2] A component presentation by weight C:0.15 - 0.40%, Si:0.05-0.50%, Mn: 2.0-3.0%, P:0.005 - 0.020%, S:0.0005 - 0.006%, aluminum: 0.01-0.08%, B:0.0010 - 0.0030%, To N:0.002 - 0.005%, Cr:0.1-0.7%, and Mo:0.1-1.5% Less than [Nb:0.01-0.20%] Ti:0.01-0.20% with the electroseamed steel pipe which contains one sort or two sorts and consists of the remainder Fe and an unescapable element It consists of an organization of the martensite by normalizing, and a bainite subject, and tensile strength is 2 150 to 180 kgf/mm. Outstanding Cr-Mo system super-high tension electroseamed steel pipe of the ductility characterized by for elongation being 10% or more and yield ratios being 0.70-0.85.
[Claim 3] The outstanding Cr-Mo system super-high tension electroseamed steel pipe of the ductility according to claim 1 or 2 characterized by an electroseamed steel pipe being a square shape or a variant steel pipe.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] For this invention, the tensile strength the super-high tension electroseamed steel pipe used for structural members, such as an automobile, especially for door reinforcement is 2 150 kgf(s)/mm. Elongation is related with the Cr-Mo system [which was economical and was excellent in ductility] super-high tension electroseamed steel pipe which is 10% or more above.
[0002]
[Description of the Prior Art] At a member, it is 2 150 kgf(s)/mm in part as one of the policies which lightweight-ization put into practice for the improvement in fuel consumption and an environmental cure is considered about structural members, such as an automobile, and aim at coexistence with safety. Ultrahigh-tensile-strength-steel tubing which exceeds is being adopted.
[0003] The approach of carrying out an after [**** tubulation] temper, i.e., hardening, or hardening temper as a steel pipe ingredient for automobile door reinforcement, as indicated by JP,3-122219,A etc., and the approach of carrying out normalizing of predetermined low alloy steel like JP,3-140441,A are common.
[0004]
[Problem(s) to be Solved by the Invention] As a Prior art, as indicated in the term of a Prior art, there are two types. First, by approach which is indicated by JP,3-122219,A etc., the special heat treatment facility processed for every piece is needed, and cautions special to reservation of a dimension configuration and the quality of the material are required, and productivity is low and has become the remarkable high thing of cost in respect of plant-and-equipment investment and productivity. Furthermore, as a manufacturing method of the square shape steel pipe which attracts attention as a rigid high structural member more, and a variant steel pipe, it is unsuitable on reservation of dimensional accuracy.
[0005] Next, although an approach like JP,3-140441,A to carry out normalizing of the predetermined low alloy steel can cancel the trouble quenching type [above-mentioned], depending on a component, the cost of materials may become high, and ductility may get worse. In the case of JP,3-140441,A, Mn is over 3% and the component with expensive nickel etc. in which manufacture with a converter is impossible as a matter of fact is contained. Moreover, about the manufacture approach of a steel pipe, and elongation, it is not carried out for whether being **. For this invention, it is more economical than a conventional method by the normalizing type, manufacture is also easy, and tensile strength is 2 150 kgf(s)/mm. The above and ductility aim at offering 10% or more of outstanding Cr-Mo system super-high tension electroseamed steel pipe.
[0006]
[Means for Solving the Problem] The place made into the summary of this invention is as follows.
[0007] A component presentation by weight (1) C:0.15 - 0.40%, Si:0.05-0.50%, Mn: 2.0-3.0%, P:0.005 - 0.020%, S:0.0005 - 0.006%, With the electroseamed steel pipe which contains aluminum:0.01-0.08%, B:0.0010 - 0.0030%, N:0.002 - 0.005%, Cr:0.1-0.7%, and Mo:0.1-1.5%, and consists of the remainder

Fe and an unescapable element It consists of an organization of the martensite by normalizing, and a bainite subject, and tensile strength is 2 150 to 180 kgf/mm. Outstanding Cr-Mo system super-high tension electroseamed steel pipe of the ductility characterized by for elongation being 10% or more and yield ratios being 0.70-0.85.

[0008] A component presentation by weight (2) C:0.15 - 0.40%, Si:0.05-0.50%, Mn: 2.0-3.0%, P:0.005 - 0.020%, S:0.0005 - 0.006%, aluminum: 0.01-0.08%, B:0.0010 - 0.0030%, To N:0.002 - 0.005%, Cr:0.1-0.7%, and Mo:0.1-1.5% Less than [Nb:0.01-0.20%] Ti:0.01-0.20% with the electroseamed steel pipe which contains one sort or two sorts and consists of the remainder Fe and an unescapable element It consists of an organization of the martensite by normalizing, and a bainite subject, and tensile strength is 2 150 to 180 kgf/mm. Outstanding Cr-Mo system super-high tension electroseamed steel pipe of the ductility characterized by for elongation being 10% or more and yield ratios being 0.70-0.85.

[0009] (3) The outstanding Cr-Mo system super-high tension electroseamed steel pipe of ductility the aforementioned (1) term whose electroseamed steel pipe is a square shape or a variant steel pipe, or given in (2) terms.

[0010] This invention is explained below at a detail. The reason for limitation is explained about a component common to claims 1-3 among the components of the steel plate first used for this invention.

[0011] When there were few amounts of C, ductility is good and was excellent in workability, but since necessary reinforcement was not obtained, the minimum was made into 0.15%. Moreover, since it is in the inclination for the cold-working nature and the toughness at the time of tubulation, such as a moldability, to fall, and the heat affected zone hardened at the time of tubulation welding of an electroseamed steel pipe and trouble was caused by cutting etc. when it exceeded 0.40%, the upper limit was made into 0.40%.

[0012] Since in the case of killed steel electric-resistance-welding nature and toughness would get worse if it is difficult on a steel-manufacture technique to press down to less than 0.05% and exceeds 0.5%, Si made 0.5% the upper limit.

[0013] Mn is required at least 2.0% or more, in order reinforcement and ductile balance are good, raise reinforcement and to secure elongation. Moreover, the minimum was made, and since the ingot with a converter became very difficult when it exceeded 3.0%, the upper limit was made into 3.0% 2.0%.

[0014] The minimum was made, and although P was an element mixed unescapable at the time of steel manufacture, since it would be easy to generate a weld zone rate at the time of the electric resistance welding of ultrahigh-tensile-strength-steel tubing especially if it is difficult on a steel-manufacture technique and exceeds 0.020%, making it to less than 0.005% made the upper limit 0.020% 0.005%.

[0015] The minimum was made, and since it would be easy to generate a weld zone rate at the time of electric resistance welding if it is difficult on a steel-manufacture technique and exceeds 0.0060%, being the element which mixes S as well as P unescapable at the time of steel manufacture, and making it to less than 0.0005% made the upper limit 0.0060% 0.0005%. In order to control further the rate at the time of the electric resistance welding by S, calcium which is the element which carries out gestalt control of the MnS may be added.

[0016] The minimum was made, and if aluminum was difficult for pressing down to less than 0.01% in the case of killed steel on a steel-manufacture technique and it exceeded 0.08%, in order that it might tend to have caused the crack of a cast piece, the endoplasm defect by oxide system huge inclusion formation, etc., it made the upper limit 0.08% 0.01%.

[0017]

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[0005] Next, although an approach like JP,3-140441,A to carry out normalizing of the predetermined low alloy steel can cancel the trouble quenching type [above-mentioned], depending on a component, the cost of materials may become high, and ductility may get worse. In the case of JP,3-140441,A, Mn is over 3% and the component with expensive nickel etc. in which manufacture with a converter is impossible as a matter of fact is contained. Moreover, about the manufacture approach of a steel pipe, and elongation, it is not carried out for whether being **. For this invention, it is more economical than a conventional method by the normalizing type, manufacture is also easy, and tensile strength is 2 150 kgf(s)/mm. The above and ductility aim at offering 10% or more of outstanding Cr-Mo system super-high tension electroseamed steel pipe.
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[0008] A component presentation by weight (2) C:0.15 - 0.40%, Si:0.05-0.50%, Mn: 2.0-3.0%, P:0.005 - 0.020%, S:0.0005 - 0.006%, aluminum: 0.01-0.08%, B:0.0010 - 0.0030%, To N:0.002 - 0.005%, Cr:0.1-0.7%, and Mo:0.1-1.5% Less than [Nb:0.01-0.20%] Ti:0.01-0.20% with the electroseamed steel pipe which contains one sort or two sorts and consists of the remainder Fe and an unescapable element It consists of an organization of the martensite by normalizing, and a bainite subject, and tensile strength is 2 150 to 180 kgf/mm. Outstanding Cr-Mo system super-high tension electroseamed steel pipe of the ductility characterized by for elongation being 10% or more and yield ratios being 0.70-0.85.

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[0010] This invention is explained below at a detail. The reason for limitation is explained about a component common to claims 1-3 among the components of the steel plate first used for this invention.

[0011] When there were few amounts of C, ductility is good and was excellent in workability, but since necessary reinforcement was not obtained, the minimum was made into 0.15%. Moreover, since it is in the inclination for the cold-working nature and the toughness at the time of tubulation, such as a moldability, to fall, and the heat affected zone hardened at the time of tubulation welding of an electroseamed steel pipe and trouble was caused by cutting etc. when it exceeded 0.40%, the upper limit was made into 0.40%.

[0012] Since in the case of killed steel electric-resistance-welding nature and toughness would get worse if it is difficult on a steel-manufacture technique to press down to less than 0.05% and exceeds 0.5%, Si made 0.5% the upper limit.

[0013] Mn is required at least 2.0% or more, in order reinforcement and ductile balance are good, raise reinforcement and to secure elongation. Moreover, the minimum was made, and since the ingot with a converter became very difficult when it exceeded 3.0%, the upper limit was made into 3.0% 2.0%.

[0014] The minimum was made, and although P was an element mixed unescapable at the time of steel manufacture, since it would be easy to generate a weld zone rate at the time of the electric resistance welding of ultrahigh-tensile-strength-steel tubing especially if it is difficult on a steel-manufacture technique and exceeds 0.020%, making it to less than 0.005% made the upper limit 0.020% 0.005%.

[0015] The minimum was made, and since it would be easy to generate a weld zone rate at the time of electric resistance welding if it is difficult on a steel-manufacture technique and exceeds 0.0060%, being the element which mixes S as well as P unescapable at the time of steel manufacture, and making it to less than 0.0005% made the upper limit 0.0060% 0.0005%. In order to control further the rate at the time of the electric resistance welding by S, calcium which is the element which carries out gestalt control of the MnS may be added.

[0016] The minimum was made, and if aluminum was difficult for pressing down to less than 0.01% in the case of killed steel on a steel-manufacture technique and it exceeded 0.08%, in order that it might tend to have caused the crack of a cast piece, the endoplasm defect by oxide system huge inclusion formation, etc., it made the upper limit 0.08% 0.01%.

[0017] B is Boron, when it becomes insufficient [reinforcement] at less than 0.001% also in the component presentation of this invention steel and exceeds 0.003%, although it is an indispensable element in order to delay a ferrite transformation in a cooling process and to obtain a high intensity transformation organization. The minimum was made, and since Constituent generated and toughness fell remarkably a total, the upper limit was made into 0.003% 0.001%.

[0018] The minimum was made, and although N was an element mixed unescapable at the time of steel manufacture, pressing down to less than 0.002% made the upper limit 0.005% 0.002%, in order to check the on-the-strength rise effectiveness of Ti and B and to cause the lack of on the strength, if it is difficult on a steel-manufacture technique and exceeds 0.005%.

[0019] Mo controls a ferrite transformation, has the description which effectiveness is in grain refining and carries out precipitation strengthening to it, obtains the organization of martensite and a bainite subject by heat treatment after tubulation, and since it is effective in raising reinforcement, it makes 0.1% or more contain. However, it was few and the minimum was made, and since the improvement in effectiveness caused ductile degradation even if it added exceeding 1.5%, the upper limit was made into 1.5% 0.1%.
[0020] Cr is a comparatively economical component, controls a ferrite transformation, obtains the bainite texture which contains martensite by heat treatment after tubulation, and since it is effective in raising reinforcement, it makes 0.1% or more contain. In this case, if it adds exceeding 0.7%, it becomes easy to generate the weld flaw by the oxide of Cr in ERW tubulation, and a troublesome inert gas seal weld is required. Therefore, the upper limit was made into 0.7%.
[0021] It is the element with which all raise the reinforcement of steel materials, and since it is effective in manufacture of a super-high tension electroseamed steel pipe, 0.01% or more may be made for effectiveness to be in grain refining and to carry out precipitation strengthening to it, in order to extend non-recrystallized gamma region in hot rolling like Mo, and to contain about Ti and Nb. However, since toughness was injured a total when 0.20% was exceeded, the minimum of Ti and Nb made the upper limit 0.20% 0.01%, respectively.
[0022] Next, a production process is explained. An example of the production process of the electroseamed steel pipe by this invention is shown in drawing 1 . It is desirable to end finish rolling for the steel of the above-mentioned component according to this invention in the 3 or more transformation point of 950-degree-Cor less Ar(s) at the time of heat middle plate thickness rolling. Especially this is required, when an improvement of toughness is desired, and when obtaining the steel plate of low strength and making tubulation easy. Since rolling in a non-recrystallized region does not exist in 950-degree-C **, toughness deteriorates reinforcement and a total, and it is Ar3. Under in the transformation point, although reinforcement rises by 2-phase region rolling, toughness falls remarkably a total. Therefore, it is Ar3 950 degrees C or less about the steel of the above-mentioned component at the time of heat middle plate thickness rolling. By ending finish rolling and rolling round on condition that this invention succeedingly above the transformation point, manufacture at a back process can consider as the quality of the material which excelled [low strength / easy] in ductility.
[0023] If winding temperature is rolled round above 600 degrees C, since the cooling rate in a coil is close to furnace cooling, overaging of the deposit of Mo etc. is carried out and it can manufacture the steel plate which a ferrite deposits and has ductility with low strength in comparison. Thus, the manufactured steel plate has sufficient ductility to form a tube to a welded tube.
[0024] Normalizing is performed as heat treatment after tubulation. This is Ac3. After heating beyond a point and austenitizing, it is about the same cooling as air cooling, and generation of a ferrite is controlled, it considers as the organization of martensite and a bainite subject, and a rise on the strength is aimed at. Normalizing temperature is set to 3+20 degree C or more of Ac(s) in consideration of dispersion in temperature, and in order that an upper limit may maintain a fine grain and may secure the balance of on-the-strength ductility, its 3+70 degree C or less of Ac(s) are desirable. Moreover, air cooling here is range whose cooling rate to 300 degrees C is a part for 10-150-degree-C/. Ac3 In heat treatment of under a point, the above-mentioned effectiveness is not acquired and predetermined reinforcement is not obtained.
[0025] Although claim 1 and the electroseamed steel pipe according to claim 2 of this invention were explained above, an electroseamed steel pipe according to claim 3 may be used. Drawing 2 shows the process according to an approach according to claim 3. Thus, by adding the spinning between the colds, manufacture of the square shape steel pipe which was excellent in flexural strength, and a variant steel pipe is possible. The example of a configuration of a square shape and a variant steel pipe is shown in drawing 3 . The spinning between the colds has an approach by dice drawing, and an approach by roll forming. Element tube heat treatment removes the processing distortion by cold working at the time of tubulation, softens the quenching hard spot of the electric-resistance-welding section, is for improving the spinning nature between the colds, and performs softening or normalizing 600 degrees C or more.

After the diaphragm between the colds removes cold-working distortion, and in order to improve the balance of on-the-strength ductility, it performs normalizing. However, since reinforcement has already risen fully when normalizing is performed as element tube heat treatment, annealing is sufficient as finishing heat treatment after the diaphragm between the colds. If it does in this way, suitable on-the-strength-ductility balance will be obtained in the combination of the amount of work hardening by cold working, and annealing temperature. Although annealing temperature is based on the rate of cold working, it is effective from 450 degrees C or more.

[0026]

[Example] The conditions which manufactured the size phi34.1xt2.0mm electroseamed steel pipe by the conventional method and this invention method, and a result are shown in Table 1. The tube straightening between the colds here performed empty length in the shape of a square shape using the dice. With a conventional method, it is 150kgf/mm<SUP>2. Although elongation cannot attain 10% even if it attains the above tensile strength, it can attain by this invention method. Moreover, according to this invention, a yield ratio (= yield strength / tensile strength) is low made with 0.70-0.85. Since it is hard to generate the buckling at the time of bending so that a yield ratio is low, bending absorbed energy becomes large and this invention is advantageous. Moreover, by adding heat treatment of normalizing after tubulation, the base material section and weld zone of this invention are uniform, and it can obtain the super-high tension electroseamed steel pipe which was excellent in toughness balance reinforcement and a total. Since various dimensions can be easily manufactured by adding the tube straightening process between the colds further after heat treatment, small lot correspondence is possible and it is economical. Moreover, since the cross section of arbitration is processible, the square tube which was excellent in bending workability can be manufactured. Furthermore, the increase of ductility and on-the-strength-ductility balance are improved by performing normalizing after the tube straightening between the colds. Moreover, by controlling the finish rolling temperature and winding temperature in heat middle plate thickness rolling proper, the material steel plate which excelled [low strength] in ductility can be manufactured, and tubulation can be made easy if needed. In addition, although this example performed tube straightening between the colds, since a strong rise will be acquired by work hardening if spinning is performed between the colds in short, effectiveness with the same said of the spinning by roll forming is acquired.

[0027]

[Table 1]

[0028]
[Table 2]

表 1

No.	区 分	化学成分 (重量%)											
		C	Si	Mn	P	S	Al	Nb	Mo	Cr	Ti	B	N
1	従来法	0.30	0.25	1.30	0.007	0.0015	0.016	0.021	2.0	0.5	0.019	0.0014	0.004
2	従来法	0.30	0.25	1.60	0.007	0.0015	0.016	0.021	0.5	2	0.019	0.0014	0.004
3	従来法	0.14	0.25	1.60	0.007	0.0015	0.016	0.030	1.5	0.0	0.019	0.0014	0.004
4	本発明2	0.15	0.25	3.00	0.007	0.0015	0.016	0.021	1.5	0.5	0.019	0.0014	0.004
5	本発明2	0.20	0.25	3.00	0.007	0.0015	0.016	0.021	1.0	0.5	0.019	0.0014	0.004
6	本発明2	0.25	0.25	2.50	0.007	0.0015	0.016	0.021	0.7	0.5	0.019	0.0014	0.004
7	本発明2	0.30	0.15	2.50	0.007	0.0015	0.016	0.021	0.5	0.5	0.019	0.0014	0.004
8	本発明2	0.35	0.15	2.00	0.007	0.0015	0.016	0.021	0.5	0.5	0.019	0.0014	0.004
9	本発明2	0.40	0.10	2.00	0.007	0.0015	0.016	0.021	0.3	0.5	0.019	0.0014	0.004
10	本発明2	0.25	0.50	2.50	0.007	0.0015	0.016	0.021	0.7	0.5	0.019	0.0014	0.004
11	本発明2	0.25	0.25	2.50	0.007	0.0015	0.016	0.195	1.0	0.5	0.019	0.0014	0.004
12	本発明2	0.25	0.25	2.50	0.007	0.0015	0.016	0.021	0.7	0.5	0.019	0.0014	0.004
13	本発明2	0.25	0.25	2.50	0.007	0.0015	0.016	0	0.5	0.5	0.197	0.0014	0.004
14	本発明2	0.30	0.25	2.50	0.007	0.0015	0.016	0.105	0.5	0.7	0	0.0014	0.004
15	本発明1	0.30	0.25	2.50	0.007	0.0015	0.016	0	0.5	0.6	0	0.0014	0.004
16	本発明3	0.25	0.25	2.50	0.007	0.0015	0.016	0.021	0.5	0.5	0.019	0.0014	0.004
17	本発明3	0.25	0.25	2.50	0.007	0.0015	0.016	0.021	0.5	0.5	0.019	0.0014	0.004
18	本発明3	0.25	0.25	2.50	0.007	0.0015	0.016	0.021	0.5	0.5	0.019	0.0014	0.004

表1 (続き)

No.	熱間圧延 仕上げ温度(℃)	熱間圧延 巻取り温度(℃)	素管熱処理(℃)	冷間伸管率(%)	仕上げ熱処理(℃)	造管前強度 (Kgf/mm²)	最終管品質 強度 (Kgf/mm²)	最終管品質 伸び(%)	最終管品質 降伏比
1	890	600	無し	0	850	125	152	8.2	0.80
2	890	600	無し	0	850	171	155	9.1	0.82
3	890	450	600	20	無し	137	155	4.0	0.95
4	890	600	無し	0	850	140	158	13.2	0.72
5	890	600	無し	0	850	110	162	12.9	0.75
6	860	700	無し	0	850	102	153	12.5	0.81
7	860	700	無し	0	850	89	160	12.3	0.75
8	860	700	無し	0	850	89	155	11.4	0.80
9	890	700	無し	0	850	87	164	10.8	0.79
10	890	700	無し	0	850	102	160	12.1	0.73
11	890	700	無し	0	850	105	180	10.5	0.75
12	890	700	無し	0	850	102	153	12.5	0.78
13	890	700	無し	0	850	89	157	12.3	0.73
14	890	700	無し	0	850	89	161	12.1	0.76
15	890	700	無し	0	850	89	161	12.1	0.80
16	890	700	700	10	850	88	157	12.0	0.81
17	890	700	700	20	850	90	156	12.1	0.80
18	890	700	850	20	600	90	158	11.5	0.85

[0029]
[Effect of the Invention] Since the special heat treatment facility which there is no need of carrying out hardening or hardening, and annealing after **** tubulation, and is processed for every piece is not needed according to this invention, it is economical. Furthermore, the square shape steel pipe and variant steel pipe which attract attention as a rigid high structural member more can manufacture easily. Moreover, since it can manufacture with a converter as compared with the conventional normalizing type and expensive alloys, such as nickel, are not contained, it is economical. Furthermore, it also sets in a property and is 2 150 kgf/mm tensile strength. Since a yield ratio is enabled to have the outstanding on-the-strength-elongation balance of 10% or more of elongation, and to manufacture above 0.70-0.85, and the super-high tension electroseamed steel pipe with which it can do low, the place which contributes on industry is size very much.

[Translation done.]

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